Agilent Technologies 8960 Series 10 E5515B Wireless Communications Test Set
Agilent Technologies E1961A AMPS/136 Mobile Test Application

Test Mode Programming Guide

Agilent Technologies

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Agilent Technologies 8960 Series 10 E5515B Wireless Communications Test Set Agilent Technologies E1961A AMPS/136 Mobile Test Application

Test Mode Programming Guide

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Agilent Technologies

Edition/Print Date

All Editions and Updates of this manual and their creation dates are listed below.

Rev. A February 2000

Rev. B June 2000

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

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Safety Symbols

Caution, refer to accompanying documents

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Frame or chassis terminal

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To completely disconnect the unit from ac mains, either disconnect the power cord, or have a qualified electrician install an external switch.

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DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN45014

Manufacturer's Name:	**Agilent Technologies UK Ltd.**	**Agilent Technologies, Inc.**
Manufacturer's Address:	**Electronic Products & Solutions Group - Queensferry South Queensferry West Lothian, EH30 9TG Scotland, United Kingdom**	**24001 E. Mission Avenue Liberty Lake Washington 99019-9599 USA**

Declares that the product

Product Name: 8960 Series 10 Wireless Communications Test Set

Model Number: E5515A,B

Product Options: This declaration covers all options of the above product.

EMC:

Conforms with the following product specifications:

Standard:	**Limit:**
CISPR11:1990 / EN55011:1991	Group 1 Class A
IEC 801-2:1991 / EN 50082-1:1992	4kV CD, 8kV AD
IEC 801-3:1984 / EN 50082-1:1992	3V/m, 27-500 MHz
IEC 801-4:1988 / EN 50082-1:1992	0.5kV signal lines, 1kV power lines

Safety:

The product conforms to the following safety standards:

IEC 61010-1(1990) +A1(1992) +A2(1995) / EN 61010-1:1993
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The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and the EMC Directive 89/336/EEC, and carries the CE mark accordingly.

South Queensferry, Scotland. ***04 May 2000***

R.M. Evans / Quality Manager

Spokane, Washington, USA. ***04 May 2000***

W.V.Roland / Reliability & Regulatory Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent, or distributor.

Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.

This product has a sound pressure emission (at the operator position) < 70 dB(A).

- Sound Pressure Lp < 70 dB(A).
- At Operator Position.
- Normal Operation.
- According to ISO 7779:1988/EN 27779:1991 (Type Test).

Herstellerbescheinigung

Diese Information steht im Zusammenhang mit den Anforderungen der Maschinenlärminformationsverordnung vom 18 Januar 1991.

- Schalldruckpegel Lp < 70 dB(A).
- Am Arbeitsplatz.
- Normaler Betrieb.
- Nach ISO 7779:1988/EN 27779:1991 (Typprüfung).

Programming the Agilent Technologies 8960 Series 10 for TIA/EIA-136 Mobile Testing in Test Mode

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1 Programming the Agilent Technologies 8960 Series 10 for TIA/EIA-136 Mobile Testing in Test Mode

Introduction

Conventions Used in This Programming Guide

Throughout this Programming Guide the term "test set" refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1961A AMPS/136 mobile test application installed.

Purpose of This Programming Guide

The test capabilities of the test set are accessible through easy-to-use GPIB programming commands. The purpose of this Programming Guide is to teach you how to write a basic control program, using the test set's GPIB command set. This program will perform fundamental manufacturing tests on a 136 mobile station with the test set operating in test mode.

About the Programming Examples Presented in This Programming Guide

Programming Language:

Programming examples presented in this Programming Guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC.

Syntax Used in Programming Examples:

1. Programming examples use the shortened form of the command syntax to minimize GPIB bus transactions. The shortened form of a command is defined by use of capital letters in the command syntax.

   Example 1. Command Syntax:

   ```
   RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?
   ```

   Example 2. Shortened Form:

   ```
   RFAN:CONT:MEAS:FREQ:AUTO?
   ```

2. Programming examples do not include default nodes. Default nodes in the command syntax are defined by enclosing the node inside the [ ] brackets.

   Example 3. Command Syntax:

   ```
   CALL[:CELL]:POWer[:SAMPlitude] -80dBm
   ```

   Example 4. Command Syntax without Default Nodes:

   ```
   CALL:POW -80dBm
   ```

3. Programming examples make extensive use of compound commands using the ; and the ;: separators. Refer to the test set's reference information for information on the definition and use of these command separators.

Complex Commands

Complex commands are used to configure the state and assign values to parameters simultaneously. Complex commands can be used to save programming steps.

Example 5. Configuring a Parameter State

```
OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"
```

turns the state of the parameter on.

Example 6. Configuring a Parameter Value

```
OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"
```

assigns a value to the parameter.

Example 7. Single Complex Command to Configure a Parameter

```
OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"
```

would set the parameter state to ON and set the value of the parameter to 10 seconds. Note that in this example the optional command mnemonic :STIMe has been included to clarify that this complex command was used to set both the state and the value.

Example 8. Shortened Complex Command

```
OUTPUT Test_set;"SET:DTXP:TIM 10 S"
```

would also set the state to ON and set the value to 10 seconds. Note that in this example, the optional command mnemonic :STIMe has been left off to shorten the complex command. This is the format that will be used throughout this programming guide.

How This Programming Guide Is Organized

The Programming Guide is organized around a typical set of tasks a control program would normally perform when testing a 136 mobile station in test mode in a manufacturing environment. The set of tasks is shown in "Figure 1. Typical Flow of Tasks Performed by Control Program" on page 17.

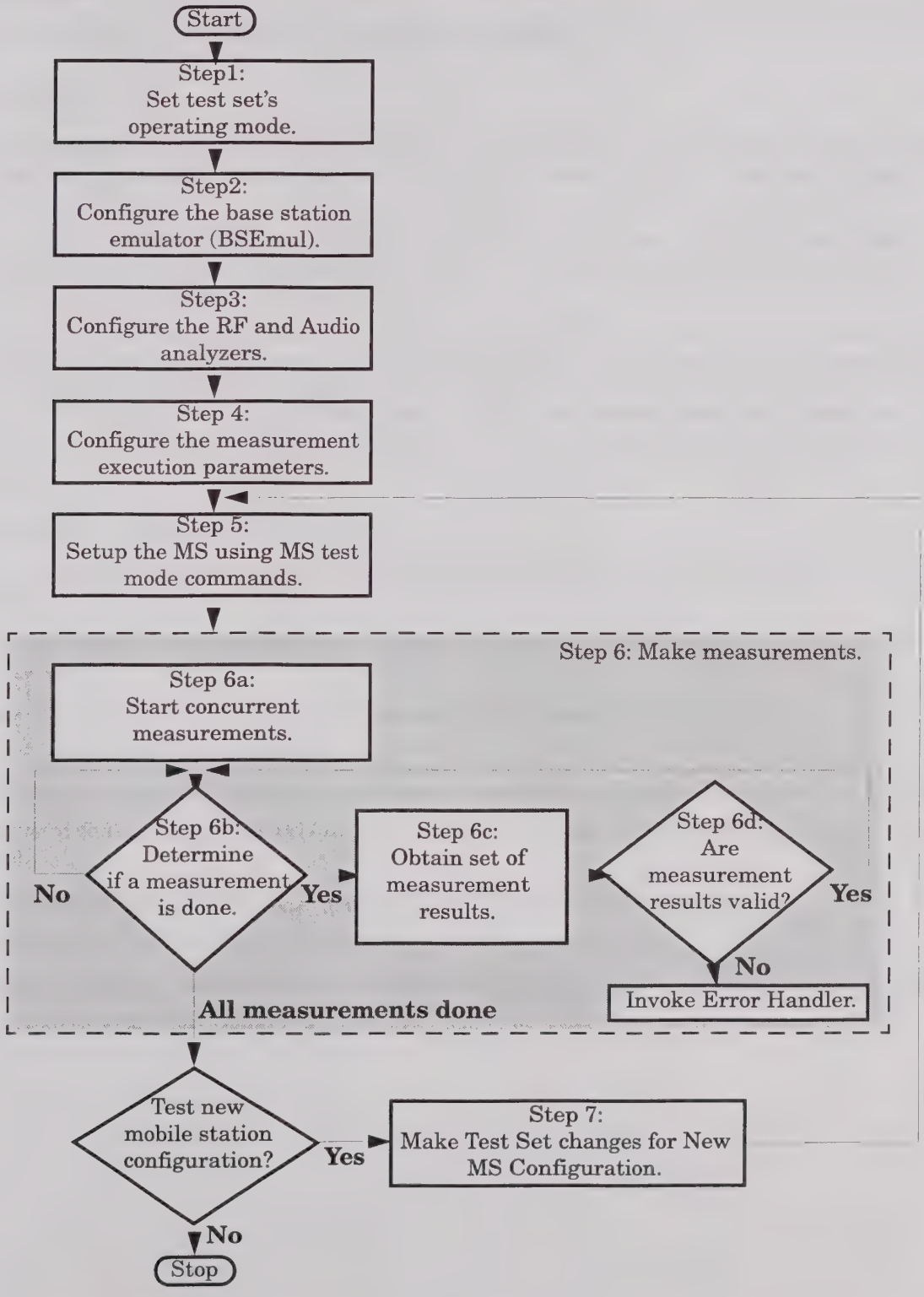
Typically in a manufacturing environment, step 4 is done once each time a production run is started and steps 5, 6, and 7 are done iteratively for each mobile tested during a production run. The number of iterations for steps 5, 6, and 7 is dependent upon how many mobile station operating conditions are being tested (that is, number of channels, number of power levels, and so fourth). Steps 1, 2, and 3 may or may not be repeated during any iteration of step 7.

How to Use This Programming Guide

This Programming Guide is divided into 8 sections. Sections 1 through 7 (step 1 through 7) should be read in sequence. Each section, in order, discusses one of the tasks to be performed by the control program, showing how to accomplish that task using the test set's GPIB command set. As you progress through each section your understanding of how the test set's GPIB interface operates will increase as you see the control program evolve.

The last section of the Programming Guide presents a "Comprehensive Program Example" on page 53 which uses all of the topics discussed in sections 1 through 7 together in one program to give the programmer a sense of how to tie everything together.

Figure 1. Typical Flow of Tasks Performed by Control Program



Step 1: Set the Test Set's Operating Mode

Background

The test set contains a TIA/EIA-136 base station emulator (BSEmul). The BSEmul's primary purpose is to provide the call processing necessary for parametric measurements on the RF and audio signals of a 136 mobile station (MS).

An important characteristic of the test set's BSEmul is its operating mode. The operating mode sets the way in which the BSEmul interacts with the mobile station. The BSEmul has four operating modes; CW mode, DTC test mode, AVC test mode, and active cell mode.

When the MS is operating in test mode, the test set should also be operated in DTC Test Mode, AVC Test Mode or CW Mode. The test being performed, the setup of the mobile, and the testing environment will determine which one should be used. While operating in a test mode, the BSEmul provides necessary forward channel stimulus and makes reverse channel measurements. It does not provide over-the-air signaling.

This Programming Guide focuses on programming the test set's BSEmul in DTC test mode, AVC test mode and CW mode.

Overview of Test Mode Operating Modes

In the two test mode operating modes, the test set's BSEmul generates a traffic channel, but does no signaling with the MS.

General Test Mode Features The basic features provided by the BSEmul when the operating mode is set to a test mode are:

- All measurements supported in the test application are available.
- No over-the-air signaling is available.
- The BSEmul automatically controls the test set's receivers, unless the user sets receiver control to manual.
- The forward channel frequency setting may be specified by the user if downlink frequency control is set to manual.

DTC Test Mode Features The basic features specific to DTC Test Mode are:

- A DTC (Digital Traffic Channel) is generated on the forward channel.
- A "forced call" can be established. See "Establishing a "Forced Call" in DTC Test Mode" on page 37.
- The Loopback BER measurement is available.

AVC Test Mode Features

The basic features specific to AVC Test Mode are:

- An AVC (Analog Voice Channel) is generated on the forward channel.
- SAT can be turned on and off.
- External and Internal FM are available.

Setting the Test Set's Operating Mode to DTC and AVC Test Mode

The test set's operating mode is set using the CALL:OPERating:MODE command.

Example 1. Command Syntax

```
CALL:OPERating:MODE <CALL|DTCTest|AVCTest|CW>
```

Example 2. Programming Example for DTC Test Mode

```
!*****************************************************************
! Step 1: Set Test Set Cell Operating Mode To DTC Test Mode
!*****************************************************************
!
OUTPUT Test_set;"CALL:OPER:MODE DTCT"
```

Example 3. Programming Example for AVC Test Mode

```
!*****************************************************************
! Step 1: Set Test Set Cell Operating Mode To AVC Test Mode
!*****************************************************************
!
OUTPUT Test_set;"CALL:OPER:MODE AVCT"
```

Overview of CW Mode

CW Mode uses the BSEmul's forward link as a basic signal generator with level and frequency control.

CW Mode Features The basic features provided when the operating mode is set to CW Mode are:

- A CW signal is generated on the forward channel.
- Receiver control is set to manual upon entering CW Mode and set to auto when exited.
- No reverse demodulation or channel decoding is available.
- All the measurements shall be accessible, although some may appear to hang if they are waiting on a trigger from protocol or may return invalid results.

Setting the Test Set's Operating Mode to CW Mode

Example 4. Programming Example for CW Mode

```
!*************************************************************
! Step 1: Set Test Set Cell Operating Mode To CW Mode
!*************************************************************
!
OUTPUT 714;"CALL:OPER:MODE CW"
```

Step 2: Configure the Base Station Emulator (BSEmul)

Background

When operating in DTC and AVC test modes, the BSEmul, using the test set's π/4 DQPSK-modulated source, generates a forward channel (BSEmul to MS direction) digital traffic channel (DTC) or an analog voice channel (AVC). This forward channel stimulus is necessary for the MS (operating in test mode) to transmit so reverse channel measurements can be made.

The BSEmul can emulate a cell in any one of the following TIA/EIA-136 frequency bands and modes:

- Cellular Analog (800 MHz)
- Cellular Digital (800 MHz)
- PCS Digital (1900 MHz)

The task of configuring the BSEmul for DTC and AVC test modes consists of configuring the traffic channels. There are numerous parameters that can be configured for the traffic channels.

In a manufacturing environment it may be desirable to explicitly configure all parameters to ensure that the settings have not been corrupted by someone setting a parameter's value through the test set's front panel.

Configuring the Traffic Channel Parameters

The traffic channel parameters are configured using the CALL processing subsystem commands shown in the following table.

Table Traffic Channel Settable Parameters

Parameter	Command Syntax	Footnotes
Cell Power	CALL[:CELL[1]]:POWer:AMPlitude<numeric value>[<suffix>]	
Cell Power State	CALL[:CELL[1]]:POWer:STATe <ON | 1 | OFF | 0>	
Cell Power and State	CALL[:CELL[1]]:POWer[:SAMPlitude]<numeric value>[<suffix>]	1
Digital Traffic Channel Band	CALL:SETup:DTC:BAND <CELLular | PCS>	2
Digital Traffic Channel Number	CALL:SETup:DTC[:CHANnel][:SELected] <numeric value> OR CALL:SETup:DTC[:CHANnel]:<CELLular | PCS> <numeric value>	
Digital Traffic Channel Timeslot	CALL:SETup:DTC:TSLot <numeric value>	
Digital Verification Color Code	CALL:SETup:DTC:DVCCode <numeric value>	
Analog Voice Channel Number	CALL:SETup:AVC[:CHANnel][:SELected] <numeric value> OR CALL:SETup:AVC[:CHANnel]:CELLular <numeric value>	4

Table Traffic Channel Settable Parameters

Parameter	Command Syntax	Footnotes
SAT Frequency	CALL:SETup:AVC:SATone[:CCODE] <SAT1|SAT2|SAT3>	5
Internal FM Source State and Deviation	CALL:FM:INTernal[:SDEViation] <numeric value>[<suffix>]	5,6
Internal FM Source State	CALL:FM:INTernal:STATe <ON|1|OFF|0>	
Internal FM Source Deviation	CALL:FM:INTernal:DEViation <numeric value>[<suffix>]	5
Internal FM Source Frequency	CALL:FM:INTernal:FREQuency <numeric value>[<suffix>]	
External FM Input State	CALL:FM:EXTernal:STATe <ON|1|OFF|0>	5,7

Table Footnotes

1 Complex command to set the amplitude to <numeric value> and state to ON in one command.

2 The DTC band setting becomes the selected band (see Note 3).

3 Sets the DTC channel for the DTC band selected with the DTC Band command (see Note 2).

4 The selected (:SELected) band is Cellular, the only available band for an AVC.

5 Make sure that the sum of the 3 FM sources (Internal FM, External FM, and SAT) does not exceed 20kHz deviation.

6 Complex command to set the internal FM source deviation and to turn the internal FM source state to ON in one command.

7 The FM deviation is fixed at 20kHz/volt with a 1 volt maximum input voltage.

Example 1. Programming Example:

```
!**********************************************************************
! Step 2: Configure the Base Station Emulator (BSEmul)
!**********************************************************************
OUTPUT Test_set;"CALL:POW -50"
OUTPUT Test_set;"CALL:SET:DTC:BAND CELL"
OUTPUT Test_set;"CALL:SET:DTC:CHAN 1"
```

Step 3: Configure the RF and Audio Analyzers

RF Analyzer

Normally, the BSEmul internal receiver parameters are controlled automatically based on what protocol expects the MS to be transmitting. However, there are times when this does not offer sufficient control for some measurement scenarios. The following internal parameters sometimes require manual control:

- Internal Measurement Frequency
- Internal Receiver Power

Measurement Receiver Frequency Controls

These Receiver Frequency Controls define whether the BSEmul's frequency tuning of the measurement receivers is controlled automatically by the BSEmul or manually by the user.

NOTE

Measurement Receiver Frequency Control is always set to manual when operating mode in CW Mode.

Configuring the Measurement Receiver Frequency Parameters When the user sets the Measurement Receiver Frequency Control to "Manual", the measurement receiver frequency is tuned to the value of the Manual Measurement Frequency.

Table 1. Measurement Receiver Frequency Control and Settable Parameters

Parameter	Command Syntax	Footnotes
Measurement Receiver Frequency Control	RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO <1|0>	
Manual Measurement Frequency	RFANalyzer:MANual:MEASurement:FREQuency <numeric value>[<suffix>]	
Manual Measurement Frequency and Control	RFANalyzer:MANual:MEASurement[:MFREQuency] <numeric value>[<suffix>]	1

Table Footnotes

1 Sets frequency to <numeric value> and control to manual in one command.

Measurement Receiver Input Power Level Controls

The Receiver Power Level Controls define whether the Internal Receiver Power parameter shall automatically be determined by the value of the MS Power Level parameter or if it shall be set manually by the user.

Configuring the Manual Receiver Power Level There are four Manual Receiver Power Level parameters:

- Manual Digital Receiver Power Level <Cellular>
- Manual Digital Receiver Power Level <PCS>
- Manual Analog Receiver Power Level <Cellular>
- Manual CW Power Level

These parameters store the Manual Receiver Power Level in units of dBm. They are applied when the Receiver Input Power Control is set to Manual.

NOTE

When operating in CW Mode, the value of the Manual CW Power Level parameter is always used, even if the Receiver Input Power Control is set to Auto.

Table 2. Manual Receiver Input Power Control and Settable Parameters

Parameter	Command Syntax
Receiver Input Power Control	RFANalyzer:CONTrol:POWer:AUTO <1|0>
Manual Analog Receiver Power Level <Cellular>	RFANalyzer:MANual:ANALog:POWer[:SELected] <numeric value>[<suffix>] OR RFANalyzer:MANual:ANALog:POWer:CELLular <numeric value>[<suffix>]
Manual Digital Receiver Power Level	RFANalyzer:MANual:DIGital:POWer[:SELected] <numeric value>[<suffix>] OR RFANalyzer:MANual:DIGital:POWer:<CELLular|PCS> <numeric value>[<suffix>]
Manual CW Power Level	RFANalyzer:CW:EXPected:POWer <numeric value>[<suffix>]

The range of the Manual Receiver Power Level parameters (-60 dBm to +53 dBm) is beyond the capability of the hardware to support. (The hardware range is -25 dBm to +43 dBm.) This is because these parameters are intended to reflect the potential range of RF power at the DUT plane. This larger range of DUT plane power levels can then be accommodated by the use of a gain or loss network between the DUT and the instrument, in conjunction with the Amplitude Offset setting.

Table 3. How to determine Test Set's Expected Receiver Power value

Operating Mode	Receiver Input Power Control	Expected Receiver Power	Range
DTC and AVC Test Modes	Auto	(Analog or Digital) MS Power Level (in cellular or PCS bands) + Amplitude Offset	-25 dBm to +43dBm
	Manual	Manual (Analog or Digital) Receiver Power Level + Amplitude Offset	
CW Mode	Manual (default) or Auto	Manual CW Power Level + Amplitude Offset	

NOTE

The Manual Receiver Power Level parameters are never overwritten by settings made to the corresponding MS TX Level parameter.

Example 1. Programming Example

```
!*********************************************************************
! Step 3: Configure the RF and Audio Analyzers
!*********************************************************************
OUTPUT Test_set;"RFAN:MAN:MEAS 870 MHZ"
OUTPUT Test_set;"RFAN:CONT:POW:AUTO OFF"
OUTPUT Test_set;"RFAN:MAN:DIG:POW:SEL 25 DBM"
```

Audio Analyzer

The Audio Analyzer Function is implemented as an "instrument" rather than a "measurement." Therefore, from the user's perspective, some parameters used for configuration are more like those associated with the BSEmul than those used by measurements.

Refer to the reference material for the additional parameters and functions associated with the Audio Analyzer.

Step 4: Configure the Measurement Execution Parameters

Background

Measurement execution parameters control the conditions under which a measurement operates. The general set of measurement execution parameters and their generic categories are as follows:

- Statistical Measurement Results (used by most measurements)

  Multi-Measurement Count State
  Multi-Measurement Count Number

- Measurement Timeouts (used by all measurements)

  Measurement Timeout
  Measurement Timeout State

- Measurement Triggering (used by most measurements)

  Trigger Arm (used by all measurements)
  Trigger Source (not used by AVC Test Mode)
  Trigger Delay (not used by AVC Test Mode)

NOTE Not all measurements use all the execution parameters shown above. Additionally, some measurements have parameters that are specific to the measurement. Each measurement has its own set of parameters that are unique to it and have no effect on the execution of other measurements. Refer to the GPIB syntax listing for a detailed list of execution parameters for individual measurements.

Overview

The SETup subsystem is used to configure measurement parameters. Each individual measurement parameter can be set and queried using the associated SETup subsystem command. The general hierarchy of the SETup subsystem command structure is as follows:

```
SETup:<meas-mnemonic>:<measurement parameter><parameter setting/value>
```

The following table shows the measurements available in the Agilent Technologies E1961A 136/AMPS mobile test application and their associated <meas-mnemonic> used in the SETup command syntax.

Table 1. Measurement Mnemonics Used In The SETup Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
IQ Tuning	IQTuning
Loopback BER	LBERror
Modulation Accuracy	MACCuracy

Configuring Statistical Measurement Results Parameters

Table 2. Statistical Measurement Results Parameters

Parameter	Command Syntax
Measurement Count Number and State	SETup:<meas-mnemonic>:COUNt[:SNUMber] <numeric value>
Measurement Count State	SETup:<meas-mnemonic>:COUNt:STATe <ON|1|OFF|0>
Measurement Count Number	SETup:<meas-mnemonic>:COUNt:NUMBer <numeric value>

Configuring Multi-Measurement Count State and Count Number Simultaneously The multi-measurement count state can be set to ON and the multi-measurement count number can be set to some value using a single complex command (See "Complex Commands" on page 15.)

Example 1. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:COUN 10"
```

would set the multi-measurement count state to ON and set the number of averages to 10 for the digital transmit power measurement.

Multi-Measurement Count State Parameter The Multi-Measurement Count State parameter is used to turn measurement averaging on and off.

Multi-Measurement Count Number Parameter The Multi-Measurement Count Number parameter sets the number of measurement samples taken during each measurement cycle when the COUNt:STATe parameter is set to ON.

Configuring Measurement Triggering Parameters

Table 3. Measurement Triggering Parameters

Parameter	Command Syntax
Trigger Arm	SETup:<meas-mnemonic>:CONTinuous <ON|1|OFF|0>
Trigger Source	SETup:<meas-mnemonic>:TRIGger:SOURce <AUTO|IMMediate|PROTocol|RISE>
Trigger Delay	SETup:<meas-mnemonic>:TRIGger:DELay <numeric value>[<suffix>]

Trigger Arm Parameter The Trigger Arm parameter determines whether a measurement will make one measurement then stop (single), or automatically re-arm upon completion of one measurement and repeat the process (continuous).

NOTE The recommended trigger arm setting for all measurements when programming the test set is single (CONTinuous OFF).

Example 2. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:CONT OFF"
```

would set the trigger arming to single for the digital transmit power measurement.

Trigger Source Parameter The Trigger Source parameter selects the source of the measurement trigger signal.

NOTE The recommended trigger source setting for all measurements when programming the test set is AUTO.

Example 3. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
```

would set the trigger source to AUTO for the digital transmit power measurement.

NOTE Trigger Source is always IMMediate for measurements in AVC Test Mode and cannot be changed by the user.

Trigger Delay Parameter

The Trigger Delay parameter controls the delay between the trigger event (the point in time at which the trigger signal is received) and the start of sampling. Negative values indicate that the sampling should occur prior to the trigger event.

Example 4. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TRIG:DEL 10 US"
```

would set the trigger delay to 10 μs for the digital transmit power measurement.

NOTE Trigger Delay is not applicable to measurements in AVC Test Mode.

Configuring Measurement Timeout Parameters

Table 4. Measurement Timeout Parameters

Parameters	Command Syntax
Measurement Timeout Time and State	`SETup:<meas-mnemonic>:TIMeout[:STIMe] <numeric value>[<suffix>]`
Measurement Timeout State	`SETup:<meas-mnemonic>:TIMeout:STATe <ON|1|OFF|0>`
Measurement Timeout Time	`SETup:<meas-mnemonic>:TIMeout:TIME <numeric value>[<suffix>]`

Configuring Measurement Timeout State and Timeout Time Simultaneously The measurement timeout state can be set to ON and the measurement timeout time can be set to some value using a single complex command (See "Complex Commands" on page 15.)

Example 5. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TIM 10"
```

would set the measurement timeout state to ON and set the measurement timeout time to 10 seconds for the digital transmit power measurement.

Measurement Timeout State Parameter The Measurement Timeout State parameter is used to enable or disable measurement timeout functionality.

Example 6. Programming Example:

```
OUTPUT Test_set;"SET:MACC:TIM:STAT ON"
```

would enable measurement timeouts for the modulation accuracy measurement.

Measurement Timeout Time Parameter

The Measurement Timeout Time parameter sets the maximum time that a measurement will execute before failing with a timeout error (when the TIMEout:STATe parameter is set to ON).

Example 7. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"
```

would set the measurement timeout time to 10 seconds for the digital transmit power measurement.

Example 8. Programming Example

```
!*****************************************************************
! Step 4: Configure Measurement Execution Parameters
!*****************************************************************
!
!  Configure Modulation Accuracy Measurement:
!
OUTPUT Test_set;"SET:MACC:COUN 5"  ! Example of using a complex
                                   ! command to set multi-meas
                                   ! state and count at same time.
OUTPUT Test_set;"SET:MACC:TRIG:SOUR AUTO"! Set trig source Auto.
OUTPUT Test_set;"SET:MACC:CONT OFF"   ! Set trig mode to single.
OUTPUT Test_set;"SET:MACC:TIM 15"     ! Set timeout time 15 sec.
OUTPUT Test_set;"SET:MACC:EVM10:STAT ON"! Turn EVM10 State ON
!
!  Configure Digital TX Power Measurement:
!
OUTPUT Test_set;"SET:DTXP:COUN 5"
OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
OUTPUT Test_set;"SET:DTXP:CONT OFF"
OUTPUT Test_set;"SET:DTXP:TIM 15"
!
!  Configure the Loopback BER Measurement
!
OUTPUT Test_set;"SET:LBER:CONT OFF;TIM 5"
OUTPUT Test_set;"SET:LBER:COUN 12000"
!
!  Configure Analog TX Power Measurement
!
OUTPUT Test_set;"SET:ATXP:COUN 5"
OUTPUT Test_set;"SET:ATXP:CONT OFF"
OUTPUT Test_set;"SET:ATXP:TIM 15"
```

Step 5: Setup the MS Using MS Test Mode Commands

Background

In DTC test mode, AVC test mode and CW mode, the test set provides forward channel stimulus but has no control over or communication with the MS. At this point, either the control program via a serial bus or other interface, or the user with the mobile's keypad, must set up the MS in order for the test set to make measurements.

Establishing a "Forced Call" in DTC Test Mode

The user may manually synchronize the MS with the test set's DTC, and then turn on the MS's own DTC. If both the reverse and forward channels use the same channel number, band, DVCC, MS Tx Power Level and timeslot, what is sometimes known as a "forced call" is in progress.

Characteristics of a "Forced Call"

- Demodulation and channel decoding of the reverse channel are available, although no messages will be decoded.
- The DTC burst contains a repeating random pattern.
- No voice echo is supported with a "forced call".

MS and test set parameters which must be the same for a "forced call" to be established

- Band
- Channel Number
- Timeslot
- DVCC
- MS Transmit Power Level

NOTE

The method used to synchronize the MS with the test set is proprietary to the MS manufacturer. The base station emulator has no direct control of synchronization when the MS is operating in test mode.

Step 6: Make Measurements

Background

The multiple signal path, DSP-based, multiple-processor architecture of the test set allows the test set to make concurrent measurements. This means that:

- multiple measurements can execute and finish at the same time (concurrently)
- individual measurement completion is not influenced by other measurement processes
- availability of measurement results is not dependent upon the sequence that the measurements were requested in
- results from measurements that take few processor cycles are available without having to wait for measurements that take many processor cycles

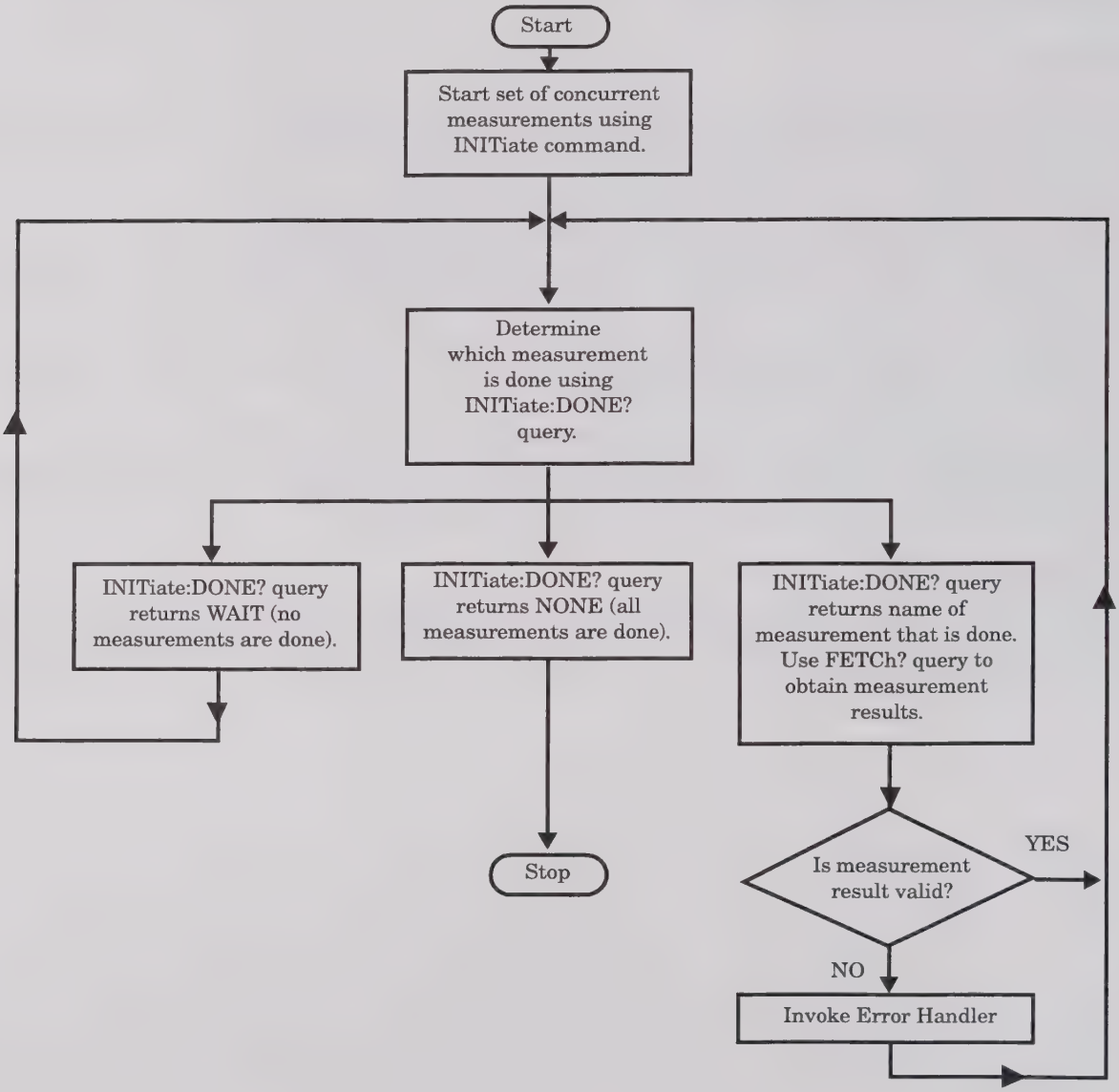
There are no special programming commands required to implement measurement concurrency.

"Step 6: Figure 1. Process for Making Concurrent Measurements" on page 40 shows the recommended process for making concurrent measurements using the test set's command set.

Making Sequential Measurements

Step 6 explains how to initiate measurements concurrently and what process to use when fetching results. These can be applied to sequential measurements. It is unnecessary to use the commands in Step 6b when performing sequential measurements.

Step 6: Figure 1. Process for Making Concurrent Measurements


Start
Start set of concurrent measurements using INITiate command.
Determine which measurement is done using INITiate:DONE? query.
INITiate:DONE? query returns WAIT (no measurements are done).
INITiate:DONE? query returns NONE (all measurements are done).
INITiate:DONE? query returns name of measurement that is done. Use FETCh? query to obtain measurement results.
Stop
Is measurement result valid?
YES
NO
Invoke Error Handler

Example 1. Programming Example:

The following program segment illustrates making a loopback BER measurement and a digital transmit power measurement concurrently using the recommended process shown in "Step 6: Figure 1. Process for Making Concurrent Measurements" on page 40.

```
!*****************************************************************
!  Step 6:  Make Measurements
!*****************************************************************
!
!  Step 6a: Start Set of Concurrent Measurements:
!
OUTPUT Test_set;"INIT:LBER;DTXP"
!
!  Step 6b:  Determine if A Measurement Is Done:
!
LOOP
   OUTPUT Test_set;"INIT:DONE?"
   ENTER Test_set;Meas_done$
!
!  Step 6c: Obtain Measurement Results
!
   SELECT Meas_done$
   CASE "DTXP"
      OUTPUT Test_set;"FETC:DTXP:INT?;POW?"
      ENTER Test_set;Integrity,Avg_dig_pow
!  Step 6d:  Are Measurement Results Valid?
      IF Integrity=0 THEN
         PRINT "AVG DIG POW= ",Avg_dig_pow
      ELSE
         GOSUB Bad_int_ind ! Go to error handling subroutine
      END IF
   CASE "LBER"
      OUTPUT Test_set;"FETC:LBER?"
      ENTER Test_set;Integrity,Bits_tested,Ber_ratio,Ber_count
!  Step 6d: Are Measurement Results Valid?
      IF Integrity=0 THEN
         PRINT "BITS TESTED = ";Bits_tested
         PRINT "BER = ";Ber_ratio
         PRINT "ERROR COUNT = ";Ber_count
      ELSE
         GOSUB Bad_int_ind ! Go to error handling subroutine
      END IF
   END SELECT
EXIT IF Meas_done$="NONE"
END LOOP
```

Things That Can Go Wrong

Measurement Integrity Always Returns a Value of 6

Background A measurement integrity value of 6 indicates that some characteristic of the input signal is under range. Typically this will be the amplitude (power) of the DUT signal. This low amplitude will cause the level of the DSP sampler to be below a threshold required by the measurement algorithm to produce results of specified accuracy.

Possible Cause One of the most likely causes of a measurement underrange condition is DUT signal loss caused by fixture loss or cable loss.

Suggested Workaround Fixture loss or cable loss can be compensated for by using the RF IN/OUT port's amplitude offset parameter.

Table 1.

Parameter	Command Syntax	Footnotes
Amplitude Offset and Correction State ON	`SYSTem:CORRection[:SGAin] <numeric value>[<suffix>]`	1
Amplitude Offset	`SYSTem:CORRection:GAIN <numeric value>[<suffix>]`	
Correction State	`SYSTem:CORRection:STATe <1|ON|0|OFF>`	

Table Footnotes

1 Complex command to set the gain to <numeric value> and state to ON in one command.

Example 2. Programming Example:

```
OUTPUT Test_set;"SYST:CORR -6"
```

would set the RF IN/OUT port's amplitude offset to –6 dB and set the correction state to ON.

Step 6a: Start Set Of Concurrent Measurements

Starting Measurements

Each measurement in a test application can be started using the INITiate command. The syntax of the INITiate command is as follows:

Example 1. Command Syntax:

```
INITiate:<meas-mnemonic>[:ON]
```

The following table shows the measurements available in the Agilent Technologies E1961A AMPS/136 mobile test application and their associated <meas-mnemonic> used in the INITiate command syntax.

Table 1. Measurement Mnemonics Used In The INITiate Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
Loopback BER	LBERror
IQ Tuning	IQTuning
Modulation Accuracy	MACCuracy

NOTE The Dynamic Transmit Power measurement closes all other active measurements when it is activated, therefore it should not be used concurrently with other measurements. Refer to the user documentation for more information.

Example 1. Programming Example:

```
OUTPUT Test_set;"INIT:DTXP"
```

would start the digital transmitter power measurement.

Using Compound Commands to Start Concurrent Measurements

More than one measurement can be started using a single INITiate command. For example:

```
OUTPUT Test_set;"INIT:DTXP;LBER"
```

would start the digital transmit power measurement and the loopback BER measurement. These measurements would then run concurrently.

Step 6b: Determine if a Measurement Is Done

Background

After a set of concurrent measurements has been started, it is desirable that the control program be able to determine when individual measurement results are available. This enables the control program to request results for a completed measurement without having to wait for other measurements to finish.

NOTE Step 6b applies only to measurements that have been initiated concurrently. When measurements have been initiated one at a time (sequential measurements) it is unnecessary to use the INITiate:DONE? query command. Step 6b can be skipped for sequential measurements.

Overview

The INITiate:DONE? query command is used to determine which measurement is finished.

As the name implies, the query returns the name of whichever active measurement is done so that the control program can request that measurement's results.

This command is query only and returns only one response per query. The responses returned and their meaning are shown in the table on the following page.

Once a measurement is reported as being done via the INITiate:DONE? query it is removed from the done list (measurements are only reported as being done once). The design of the INITiate:DONE? query assumes the control program immediately fetches a measurement's results once it is reported as being done.

Table 1. Responses Returned from INITiate:DONE? Query

Response	Meaning
ACP	The adjacent channel power measurement is done.
ATXP	The analog transmit power measurement is done.
AFAN	The audio analyzer measurement is done.
DPOW	The dynamic transmit power measurement is done.
DTXP	The digital transmit power measurement is done.
FM	The frequency modulation measurement is done.
FST	The frequency stability measurement is done.
IQT	The IQ Tuning measurement is done.
LBER	The loopback BER measurement is done.
MACC	The modulation accuracy measurement is done.
WAIT	There are one or more measurements that are in progress, but none of those measurements are done yet.
NONE	No measurements are in progress.

Example 1. Command Syntax:

```
INITiate:DONE?
```

Step 6c: Obtain a Set of Measurement Results

Background

In order to minimize bus traffic in the manufacturing environment, the test set's high-level measurements have been designed to return multiple measured values in response to a single measurement request.

For example, if a digital transmit power measurement with statistical measurement results is initiated, there will be five measurement results available as follows:

1. Measurement integrity value
2. Average value
3. Minimum value
4. Maximum value
5. Standard deviation value

The test set has been designed with the capability to return the measurement results in a variety of formats to suit the needs of the measurement environment. For example, the digital transmitter power measurement results can be returned as:

- Measurement integrity and average value

  OR

- Average value and minimum value and maximum value and standard deviation value

  OR

- Average value only

  OR

- Minimum value only

  OR

- Maximum value only

  OR

- Standard deviation value only

  OR

- Measurement integrity value only

The formats available for individual measurements can be found in the test set's FETCh subsystem's GPIB command syntax reference information.

Overview

The measurement results from each measurement in a test application can be queried using the FETCh subsystem. The general hierarchy of the FETCh command structure is as follows:

```
FETCh:<meas-mnemonic>:<result format>?
```

The following table shows the measurements available in the Agilent Technologies E1961A AMPS/136 mobile test application and their associated <meas-mnemonic> used in the FETCh command syntax.

The command syntax used to obtain the various measurement result formats (<result format>) for each measurement can be found in the test set's FETCh subsystem's GPIB command syntax reference information.

Table 1. Measurement Mnemonics Used In The FETCh Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
IQ Tuning	IQTuning
Loopback BER	LBERror
Modulation Accuracy	MACCuracy

Example 1. Command Syntax:

```
FETCh:<meas-mnemonic>:<result format>?
```

Example 2. Programming Example:

```
OUTPUT Test_set;"FETC:DTXP:POW:MIN?"
```

would return the minimum value from the set of samples taken during the digital transmit power measurement (when statistical measurement results are turned on and number of samples taken >1). The returned value can be assigned to a variable using the following HP Basic command:

```
ENTER Test_set;Min_dig_pow
```

Step 6d: Validate Measurement Results

Background

Validating measurement results is extremely important when using test modes. The test set will return a result if it is capable of making a measurement, even if this result was obtained under adverse conditions. The lack of signaling between the mobile and the test set prevents the test set from knowing the condition of the link. Therefore, the only indicator provided by the test set that the measurement conditions were unacceptable becomes the integrity indicator. It is essential to check the value returned for the integrity indicator of each measurement.

For example, when a "forced call" is established the MS should be synchronized with the test set. In some cases, the MS may not successfully synchronize to the test set but will still begin to transmit. The test set will make measurements, but they will be triggered in the wrong place and the results will most likely be invalid. When making measurements in DTC test mode, it is possible to set up the mobile on the correct channel and the wrong timeslot and still have the mobile's transmitter turn on. The test set WILL return values for the measurements but will also return integrity indicators other than 0.

Overview

The integrity indicator is a measurement result and therefore is queried using the FETCh subsystem. A value of 0 indicates that the measurement is valid. A value other than 0 indicates that an error occurred during the measurement process.

Table 1. Integrity Indicators

Value Returned	Description (Message also appears on Test Set)
0	Normal
1	No Result Available
2	Measurement Timeout
3	Hardware Not Installed
4	Hardware Error
5	Over Range
6	Under Range
7	Burst Short
8	Trigger Early or Fall Early
9	Trigger Late or Rise Late
10	Signal Too Noisy
11	Sync Not Found
12	Oven Out of Range
13	Unidentified Error

Example 1. Programming Example

```
OUTPUT Test_set;"FETC:DTXP?"
ENTER Test_set;Integrity,Avg_dig_pow
IF Integrity=0 THEN
   PRINT "AVG DIG POW= ";Avg_dig_pow
ELSE
   PRINT "DTXP Measurement Error"
   PRINT "DTXP Measurement Integrity is ";Integrity
END IF
```

Step 7: Make Test Set Changes for New MS Configuration

Background

The test set must be put into any new configuration before the MS in order for the MS to be able to synchronize to the test set. This involves repeating steps 1, 2, or 3 or any combination of the three. It is only necessary to perform step 4 once. Therefore, it is possible to set up both digital and analog measurements all at once and later initiate them when the test set is in the appropriate operating mode.

Possible Test Set Changes

Repeat Step 1: Set the Test Set's Operating Mode

This step would be appropriate if all tests in one operating mode have been completed and more tests need to be performed in a different operating mode. There are four operating modes: DTC Test Mode, AVC Test Mode, CW Mode, and Active Cell Mode.

Repeat Step 2: Configure the Base Station Emulator

This step would be appropriate if testing at a new power level, channel, timeslot, or band.

Repeat Step 3: Configure the RF and Audio Analyzers

This step would be appropriate if testing at a new power level, frequency, timeslot, or band and control of the receiver was manual. Another instance would be if audio tests were to be performed.

Comprehensive Program Example

This section presents two example programs for making measurements using the test set in DTC and AVC test modes. The first program follows the task flow presented at the beginning of this programming guide and illustrates how each step presented throughout the guide fits together into a single program. The second program is an example of more efficient programming techniques.

Example Program 1

```
10    !*****************************************************************
20    !  Program: PROG_EX.TXT                                    11/18/99
30    !  Purpose:  Comprehensive Example of programming measurements on
40    !            the HP 8960 using DTC and AVC test modes.
50    !            This example is written in HP BASIC.
60    !*****************************************************************
70    !
80    !  Configure the HP BASIC environment.
90    !  These actions are unrelated to configuring or performing tests
100   !     with the HP 8960.
110   !
120   OPTION BASE 1
130   COM Test_set
140   Test_set=714!  Test set's HP-IB address
150   PRINTER IS CRT
160   CLEAR SCREEN
170   ON TIMEOUT 7,10 GOTO Timeout_routine
180   !
190   !  Turn on the HP-IB debugger.
200   OUTPUT Test_set;"SYST:COMM:GPIB:DEB:STAT ON"
210   !
220   !*****************************************************************
230   ! Step 1: Set Test Set Cell Operating Mode To DTC Test Mode
240   !*****************************************************************
250   !
260   OUTPUT Test_set;"CALL:OPER:MODE DTCT"
270   !*****************************************************************
280   ! Step 2: Configure the Base Station Emulator (BSEmul)
290   !*****************************************************************
300   OUTPUT Test_set;"SYST:CORR -1"! MS has a -1 dB fixture loss
310   OUTPUT Test_set;"CALL:POW -50"! Set cell power to -50 dBm and turn
320                                  ! power state ON with complex command
330   OUTPUT Test_set;"CALL:SET:DTC:BAND CELL"! Set active band to cell
340   OUTPUT Test_set;"CALL:SET:DTC:CHAN 42"! Set traffic channel to 42
350   !
360   !*****************************************************************
370   ! Step 4: Configure Measurement Execution Parameters
380   !*****************************************************************
390   !
400   !  Configure Modulation Accuracy Measurement:
410   !
```

```
420   OUTPUT Test_set;"SET:MACC:COUN 5"  ! Example of using a complex
430                                      ! command to set multi-meas
440                                      ! state and count at same time.
450   OUTPUT Test_set;"SET:MACC:TRIG:SOUR AUTO"! Set trig source Auto.
460   OUTPUT Test_set;"SET:MACC:CONT OFF"   ! Set trig mode to single.
470   OUTPUT Test_set;"SET:MACC:TIM 15"     ! Set timeout time 15 sec.
480   OUTPUT Test_set;"SET:MACC:EVM10:STAT ON"! Turn EVM10 State ON
490   !
500   !  Configure Digital TX Power Measurement:
510   !
520   OUTPUT Test_set;"SET:DTXP:COUN 5"
530   OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
540   OUTPUT Test_set;"SET:DTXP:CONT OFF"
550   OUTPUT Test_set;"SET:DTXP:TIM 15"
560   !
570   !  Configure Analog TX Power Measurement
580   !
590   OUTPUT Test_set;"SET:ATXP:COUN 5"
600   OUTPUT Test_set;"SET:ATXP:CONT OFF"
610   OUTPUT Test_set;"SET:ATXP:TIM 15"
620   !
630   !  Configure Frequency Stability Measurement
640   !
650   OUTPUT Test_set;"SET:FST:CONT OFF;COUN 10;TIM 15"
660   !
670   !*****************************************************************
680   !  Step 5:  Set Up The MS Using MS Test Mode Commands
690   !*****************************************************************
700   PRINT "PUT THE MS INTO DIGITAL TEST MODE NOW"
710   PRINT "PRESS CONTINUE"
720   PAUSE
730   !*****************************************************************
740   !  Step 6:  Make Measurements
750   !*****************************************************************
760   !
770   !  Step 6a: Start Set of Concurrent Measurements:
780   !
790   OUTPUT Test_set;"INIT:DTXP;MACC"
800   !
810   !  Step 6b:  Determine if A Measurement Is Done:
820   !
830   LOOP
840      OUTPUT Test_set;"INIT:DONE?"
850      ENTER Test_set;Meas_done$
860   !
870   !  Step 6c: Obtain Measurement Results
880   !
890      SELECT Meas_done$
900      CASE "MACC"
910         GOSUB Mod_acc  !Example of using a subroutine to query
920      CASE "DTXP"
930         OUTPUT Test_set;"FETC:DTXP:INT?;POW?"
940         ENTER Test_set;Integrity,Avg_dig_pow
```

```
950         IF Integrity=0 THEN
960            PRINT "AVG DIG POW= ",Avg_dig_pow
970         ELSE
980            GOSUB Bad_int_ind
990   !
1000  !  Step 6d: Are Measurement Results Valid?
1010  !
1020        END IF
1030     END SELECT
1040  EXIT IF Meas_done$="NONE"
1050  END LOOP !  If 'WAIT' is returned from the 'INIT:DONE?' query, it
1060           !  will fall through the loop
1070  !*****************************************************************
1080  !  Step 7:  Make Test Set Changes for New MS Configuration
1090  !*****************************************************************
1100  !
1110  !  Proceed to analog tests
1120  !
1130  !*****************************************************************
1140  ! Step 1(REPEATED): Set Test Set Cell Operating Mode AVC Test Mode
1150  !*****************************************************************
1160  !
1170  OUTPUT Test_set;"CALL:OPER:MODE AVCT"
1180  !*****************************************************************
1190  ! Step 2: Configure the Base Station Emulator (BSEmul)
1200  !*****************************************************************
1210  OUTPUT Test_set;"CALL:SET:AVC:CELL 42"! Set channel number
1220  !*****************************************************************
1230  !  Step 5(REPEATED):  Set Up The MS Using MS Test Mode Commands
1240  !*****************************************************************
1250  PRINT " "
1260  PRINT "PUT THE MS INTO ANALOG TEST MODE NOW"
1270  PRINT "PRESS CONTINUE"
1280  PAUSE
1290  !
1300  !*****************************************************************
1310  !  Step 6(REPEATED):  Make Measurements
1320  !*****************************************************************
1330  !
1340  !  Step 6a: Start Set of Concurrent Measurements:
1350  !
1360  OUTPUT Test_set;"INIT:ATXP;FST"
1370  !
1380  !
1390  !  Step 6b:  Determine if a measurement is done:
1400  LOOP
1410     OUTPUT Test_set;"INIT:DONE?"
1420     ENTER Test_set;Ana_meas_done$
1430  !
1440  !  Step 6c: Obtain Measurement Results
1450  !
1460     SELECT Ana_meas_done$
1470  !
```

```
1480     CASE "ATXP"
1490        OUTPUT Test_set;"FETC:ATXP?"
1500        ENTER Test_set;Integrity,Avg_ana_pow
1510        IF Integrity=0 THEN
1520           PRINT "AVG ANALOG POW= ",Avg_ana_pow
1530        ELSE
1540           GOSUB Bad_int_ind
1550        END IF
1560     CASE "FST"
1570        OUTPUT Test_set;"FETC:FST?"
1580        ENTER Test_set;Integrity,Wfreq_err,Avg_freq
1590        IF Integrity=0 THEN
1600           PRINT
1610           PRINT "Analog Frequency Stability Measurement Results"
1620           PRINT "Worst Frequency Error = ";Wfreq_err
1630           PRINT "Average Frequency = ";Avg_freq
1640        ELSE
1650           GOSUB Bad_int_ind
1660        END IF
1670     END SELECT
1680  EXIT IF Ana_meas_done$="NONE"
1690  END LOOP
1700  !*****************************************************************
1710  !  Step 7(REPEATED):  Test Set Changes for New MS Configuration
1720  !*****************************************************************
1730  !
1740  !  Proceed to audio tests
1750  !
1760  !*****************************************************************
1770  ! Step 2: Configure the Base Station Emulator (BSEmul)
1780  !*****************************************************************
1790  !
1800  OUTPUT Test_set;"CALL:POW -116 DBM"
1810  OUTPUT Test_set;"CALL:SET:AVC 600"
1820  !
1830  !*****************************************************************
1840  ! Step 3: Configure the RF and Audio analyzers
1850  !*****************************************************************
1860  OUTPUT Test_set;"CALL:FM:INT:FREQ 1004 HZ;SDEV 8 KHZ"
1870  OUTPUT Test_set;"CALL:AVCT:AVC:SAT:STAT OFF"
1880  OUTPUT Test_set;"SET:AFAN:CONT OFF;TIM 15"
1890  OUTPUT Test_set;"SET:AFAN:PEAK:VOLT 3V"
1900  OUTPUT Test_set;"SET:AFAN:SDIS:STAT ON"
1910  OUTPUT Test_set;"SET:AFAN:SDIS:FREQ 1004 HZ"
1920  OUTPUT Test_set;"SET:AFAN:FILT CMES"
1930  OUTPUT Test_set;"SET:AFAN:DEMP:STAT OFF"
1940  OUTPUT Test_set;"SET:AFAN:EXP:STAT OFF"
1950  !*****************************************************************
1960  !  Step 5(REPEATED):  Set Up The MS Using MS Test Mode Commands
1970  !*****************************************************************
1980  PRINT " "
1990  PRINT "CONFIGURE THE MS FOR RECEIVER SENSITIVITY TESTING"
2000  PRINT "SET THE PHONE FOR A MIDDLE CHANNEL IN THE CELL BAND"
```

```
2010  PRINT "POWER LEVEL OF 0"
2020  PRINT "PRESS CONTINUE"
2030  PAUSE
2040  !
2050  !*****************************************************************
2060  !  Step 6(REPEATED):  Make Measurements
2070  !*****************************************************************
2080  !
2090  OUTPUT Test_set;"INIT:AFAN"
2100  OUTPUT Test_set;"FETC:AFAN:INT?;SINAD?"
2110  ENTER Test_set;Integrity,Avg_sinad
2120  IF Integrity=0 THEN
2130     PRINT
2140     PRINT "Receiver Sensitivity Results"
2150     PRINT "SINAD = ";Avg_sinad;"dBm"
2160  ELSE
2170     PRINT "MEASUREMENT FAILED"
2180     PRINT "INTEGRITY = ";Integrity
2190  END IF
2200  !
2210  !  Change power for Distortion measurement
2220  !
2230  OUTPUT Test_set;"CALL:POW -50 DBM"
2240  !
2250  !  Measure Distortion
2260  !
2270  OUTPUT Test_set;"INIT:AFAN"
2280  OUTPUT Test_set;"FETC:AFAN:INT?;DIST?"
2290  ENTER Test_set;Integrity,Avg_distortion
2300  IF Integrity=0 THEN
2310     PRINT
2320     PRINT "Average Distortion Results"
2330     PRINT "Distortion = ";Avg_distortion;"%"
2340  ELSE
2350     PRINT "MEASUREMENT FAILED"
2360     PRINT "INTEGRITY = ";Integrity
2370  END IF
2380  STOP
2390  !
2400  !  Subroutines
2410  !
2420 Mod_acc:!  Query and output results for MACC
2430  OUTPUT Test_set;"FETC:MACC:INT?;EVM10?"
2440  ENTER Test_set;Integrity,Max_evm10
2450  IF Integrity=0 THEN
2460     PRINT "MAX EVM10 = ",Max_evm10
2470  ELSE
2480     GOSUB Bad_int_ind
2490  END IF
2500  RETURN
2510 Bad_int_ind: !
2520  PRINT Meas_done$&" Measurement Error"
2530  PRINT "Measurement Integrity Indicator: ",Integrity
```

```
2540  RETURN
2550 Timeout_routine: !
2560  PRINT "GPIB timeout has occurred."
2570  END
```

Example Program 2

```
10    !****************************************************************
20    ! Comprehensive Example Program
30    ! 8960 AMPS/136 Test Mode
40    !
50    ! This is an example program to demonstrate the use of Momentum
60    ! with AMPS/136 TA testing a dual-mode TDMA phone in Test Mode.
70    ! The program makes Digital Cellular, Digital PCS, and Analog
80    ! measurements in Test (no call processing) Mode.
90    !****************************************************************
100   !
110   COM /Address/ INTEGER Testset
120   Testset=714
130   ON TIMEOUT 7,20 GOSUB Timeout
140   Rf_level=-50
150   Ber_level=-110
160   Sinad_level=-116
170   CLEAR SCREEN
180   !
190   !****************************************************************
200   ! Configure Testset Parameters
210   !****************************************************************
220   !
230   OUTPUT Testset;"*RST"
240   OUTPUT Testset;"SYST:COMM:GPIB:DEB:STAT ON"
250   !
260   !****************************************************************
270   ! Configure Base Station Emulator Parameters
280   !****************************************************************
290   !
300   OUTPUT Testset;"CALL:CELL:OPER:MODE DTCT"
310   OUTPUT Testset;"SYST:CORR -0.7DB"
320   OUTPUT Testset;"CALL:POW ";Rf_level
330   OUTPUT Testset;"CALL:SET:AVC 400"
340   OUTPUT Testset;"CALL:SET:DTC:BAND CELL"
350   OUTPUT Testset;"CALL:SET:DTC:CHAN:CELL 42"
360   OUTPUT Testset;"CALL:SET:DTC:CHAN:PCS 1000"
370   OUTPUT Testset;"RFAN:CONT:POW:AUTO OFF"
380   OUTPUT Testset;"RFAN:MAN:ANAL:POW 25"
390   OUTPUT Testset;"RFAN:MAN:DIG:POW:CELL 25"
400   OUTPUT Testset;"RFAN:MAN:DIG:POW:PCS 25"
410   OUTPUT Testset;"CALL:FM:INT:STATE OFF;DEV 8KHZ;FREQ 1004HZ"
420   !
430   !****************************************************************
440   ! Configure Measurement Parameters
450   !****************************************************************
460   !
470   OUTPUT Testset;"SET:CONT:OFF"
480   OUTPUT Testset;"SET:DTXP:TIM 3"
490   OUTPUT Testset;"SET:MACC:TIM 3"
500   OUTPUT Testset;"SET:ACP:TIM 3"
510   OUTPUT Testset;"SET:LBER:COUN 10000;TIM 3"
```

```
520   OUTPUT Testset;"SET:FST:TIM 3"
530   OUTPUT Testset;"SET:ATXP:TIM 3"
540   OUTPUT Testset;"SET:AFAN:TIM 3"
550   OUTPUT Testset;"SET:FM:TIM 3"
560   OUTPUT Testset;"SET:MACC:EVM10:STAT OFF"
570   OUTPUT Testset;"SET:AFAN:PEAK:VOLT 1"
580   OUTPUT Testset;"SET:AFAN:SDIS:STAT ON"
590   OUTPUT Testset;"SET:AFAN:FILT CMES"
600   OUTPUT Testset;"SET:AFAN:SDIS:STATE ON;FREQ 1004"
610   OUTPUT Testset;"SET:FM:DIST:STATE ON;FREQ 6000"
620   OUTPUT Testset;"SET:FM:DETECTOR:TYPE PPEAK"
630   OUTPUT Testset;"SET:FM:FILT:TBP 6000"
640   OUTPUT Testset;"SET:FM:FILT TBP"
650   !
660   !*************************************************************
670   ! Put Mobile in Test Mode (Digital Cellular)
680   !*************************************************************
690   !
700   PRINT "Put phone in DTC Test Mode, Channel 42, Slot 1, DVCC 1."
710   PRINT "Press 'F2' to continue."
720   PAUSE
730   CLEAR SCREEN
740   PRINT "Cellular Results: "
750   !
760   !*************************************************************
770   ! Make Measurements (Digital Cellular and PCS)
780   !*************************************************************
790   !
800   FOR I=1 TO 2
810     OUTPUT Testset;"CALL:POW ";Ber_level
820     OUTPUT Testset;"INIT:LBER;DTXP;MACC;ACP"
830     REPEAT
840       OUTPUT Testset;"INIT:DONE?"
850       ENTER Testset;Measdone$
860       SELECT Measdone$
870       CASE "LBER"
880         OUTPUT Testset;"FETC:LBER:INT?;RAT?"
890         ENTER Testset;Integrity,Ber
900         IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
910         Print_results(Measdone$,Ber)
920       CASE "DTXP"
930         OUTPUT Testset;"FETC:DTXP?"
940         ENTER Testset;Integrity,Power
950         IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
960         Print_results(Measdone$,Power)
970       CASE "MACC"
980         OUTPUT Testset;"FETC:MACC?"
990         ENTER Testset;Integrity,Evm,Ferr,Ooff,Perr,Mag
1000        IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1010        Print_results(Measdone$,Evm,Ferr,Ooff,Perr,Mag)
1020      CASE "ACP"
1030        OUTPUT Testset;"FETC:ACP?"
1040        ENTER Testset;Integrity,Adj1,Adjh,Alt1l,Alt1h,Alt2l,Alt2h
```

```
1050        IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1060        Print_results(Measdone$,Adj1,Adjh,Alt11,Alt1h,Alt21,Alt2h)
1070      END SELECT
1080    UNTIL Measdone$="NONE"
1090    OUTPUT Testset;"CALL:POW ";Rf_level
1100  !
1110  !*************************************************************
1120  ! Make Test Set Changes (Change to PCS, then Analog)
1130  !*************************************************************
1140  !
1150  !
1160    IF I=1 THEN ! Just did Digital 800, get ready for Digital 1900
1170      OUTPUT Testset;"CALL:SET:DTC:BAND PCS"
1180    ELSE   ! Done doing Digital 1900, get ready for Analog
1190      OUTPUT Testset;"CALL:CELL:OPER:MODE AVCT"
1200    END IF
1210  !
1220  !*************************************************************
1230  ! Change Phone's Test Mode (Digital PCS first, Analog Second)
1240  !*************************************************************
1250  !
1260    !
1270    IF I=1 THEN           !Finished with 800MHz, Change to 1900MHz
1280      PRINT "Change phone's channel to 1000 PCS, DVCC 1, Slot 1."
1290      PRINT "Press Continue."
1300      PAUSE
1310      PRINT
1320      PRINT "PCS Results:"
1330    ELSE        !Finished with Digital, change to analog test mode
1340      PRINT "Put phone in Analog Test Mode, Channel 400, SAT ON."
1350      PRINT "Press Continue."
1360      PAUSE
1370      PRINT
1380      PRINT "Analog Results:"
1390    END IF
1400  NEXT I
1410  !
1420  !*************************************************************
1430  ! Make Measurements (Analog RF,Audio,FM)
1440  !*************************************************************
1450  !
1480  OUTPUT Testset;"CALL:FM:INT:STATE ON"
1490  OUTPUT Testset;"CALL:POW ";Sinad_level
1500  OUTPUT Testset;"INIT:ATXP;FST;AFAN;FM"
1510  REPEAT
1520    OUTPUT Testset;"INIT:DONE?"
1530    ENTER Testset;Measdone$
1540    SELECT Measdone$
1550    CASE "ATXP"
1560      OUTPUT Testset;"FETC:ATXP?"
1570      ENTER Testset;Integrity,Power
1580      IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1590      Print_results(Measdone$,Power)
```

```
1600    CASE "FST"
1610      OUTPUT Testset;"FETC:FST?"
1620      ENTER Testset;Integrity,Ferr,Freq
1630      IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1640      Print_results(Measdone$,Ferr,Freq)
1650    CASE "AFAN"
1660      OUTPUT Testset;"FETC:AFAN?"
1670      ENTER Testset;Integrity,Level,Sinad,Dist
1680      IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1690      Print_results(Measdone$,Level,Dist,Sinad)
1700    CASE "FM"
1710      OUTPUT Testset;"FETC:FM?"
1720      ENTER Testset;Integrity,Dev,Dist
1730      IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1740      Print_results(Measdone$,Dev,Dist)
1750    END SELECT
1760  UNTIL Measdone$="NONE"
1770  !
1780  !*****************************************************************
1790  ! Finish Testing
1800  !*****************************************************************
1810  !
1820  PRINT "Testing Complete."
1830  PRINT
1840  OUTPUT Testset;"CALL:POW ";Rf_level
1850  STOP
1860 Timeout:   !Comes here only when program times out
1870  PRINT "Program time out."
1880  END
1890  !
1900  !*****************************************************************
1910  ! Subroutine Section
1920  !*****************************************************************
1930  SUB Print_results(Meas_name$,Res1,OPTIONAL Res2,Res3,Res4,Res5,Res6)
1940    SELECT Meas_name$
1950    CASE "LBER"
1960      PRINT USING "5X,""Loopback BER:"",10X,M2D.2D,"" %""";Res1
1970    CASE "DTXP"
1980      PRINT USING "5X,""Ave Digital Power:"",5X,M2D.2D,"" dBm""";Res1
1990    CASE "MACC"
2000      PRINT USING "5X,""Max EVM1:"",14X,M2D.2D,"" %""";Res1
2010      PRINT USING "5X,""Worst Freq Error:"",5X,M3D.2D,"" Hz""";Res2
2020      PRINT USING "5X,""Max Mag. Error:"",8X,M2D.2D,"" %""";Res5
2030      PRINT USING "5X,""Max Origin Offset:"",5X,M2D.2D,"" dB""";Res3
2040      PRINT USING "5X,""Max Phase Error:"",7X,M2D.2D,"" Deg""";Res4
2050    CASE "ACP"
2060      PRINT USING "5X,""ACP Adj Lo:"",12X,M2D.2D,"" dBc""";Res1
2070      PRINT USING "5X,""ACP Adj Hi:"",12X,M2D.2D,"" dBc""";Res2
2080      PRINT USING "5X,""ACP Alt1 Lo:"",11X,M2D.2D,"" dBc""";Res3
2090      PRINT USING "5X,""ACP Alt1 Hi:"",11X,M2D.2D,"" dBc""";Res4
2100      PRINT USING "5X,""ACP Alt2 Lo:"",11X,M2D.2D,"" dBc""";Res5
2110      PRINT USING "5X,""ACP Alt2 Hi:"",11X,M2D.2D,"" dBc""";Res6
2120    CASE "ATXP"
```

```
2130      PRINT USING "5X,""Ave Analog Power:"",6X,M2D.2D,"" dBm""";Res1
2140    CASE "FST"
2150      PRINT USING "5X,""Worst Freq Error:"",5X,M3D.2D,"" ppm""";Res1
2160      PRINT USING "5X,""Average Freq:"",6X,M3D.2DESZ,"" Hz""";Res2
2170    CASE "FM"
2180      PRINT USING "5X,""SAT Deviation:"",9X,M5D,"" Hz""";Res1
2190      PRINT USING "5X,""Distortion:"",11X,M3D.2D,"" %""";Res2
2200    CASE "AFAN"
2210      PRINT USING "5X,""Audio Level:"",10X,M3D.2D,"" V""";Res1
2220      PRINT USING "5X,""Audio Distortion:"",5X,M3D.2D,"" %""";Res2
2230      PRINT USING "5X,""SINAD:"",16X,M3D.2D,"" dB""";Sinad
2240    END SELECT
2250  SUBEND
2260  SUB Bad_measurement(Integrity,Meas_name$)
2270    PRINT "     Measurement warning: ";Meas_name$
2280    PRINT "     Integrity =";Integrity
2290  SUBEND
```

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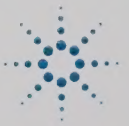

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